The Effects of the 2006 Tuition Fee Reform and the Great Recession on University Student Dropout Behaviour in the UK

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Abstract

This paper investigates the causal effect of the Great Recession, and a conditional effect of a tuition fee reform, on the risk of students dropping out of HE. We use HESA data and our analysis combines duration modelling with difference-in-differences. We find that the causal effect of the recession increases the risk of drop out, especially for males. A smaller and positive effect of the tuition fee reform for males, whereas we observe the opposite effect for females. Differences in dropout behaviour are also found for high and low income groups, and between different types of university and subjects studied.
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1 Introduction

Dropping out of education can be costly for individuals, especially if there is an increased risk of unemployment and associated lower lifetime earnings (Arulampalam et al., 2005), for universities insofar as income is reduced, and for society as a whole, especially when the state subsidy to education is high. The Great Recession, which in the UK occured between 2007-2009, led to rising rates of unemployment especially amongst school-leavers and graduates (Bell and Blanchflower, 2010). Substantial increases in unemployment are likely to create uncertainty regarding future employment and wage prospects post-graduation and so may have also influenced student drop out behaviour. Furthermore, countries like the US and the UK have witnessed an increase in participation rates in higher education, and dropout rates have remained high as more marginal (in terms of ability) students have enrolled on university courses. With the increase in participation rates, and associated increased taxation to finance this expansion, it is no surprise that governments should look for alternative funding mechanisms. In recent years, successive UK governments have sought to reduce the subsidy to higher education and have pushed more of these costs onto the beneficiaries of their education - the students.

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This paper estimates the effect of the recession (hereafter the recession effect), and the effect of a tuition fee increase, which was introduced in the academic year 2006/07 (the reform effect), on the dropout behaviour of first year university students in England. Our data show that approximately one in ten students dropped out of their first year of study in the period 2004-2008, however, this fell following the reform and the recession to around one in twenty first year students. The problem of university drop out is therefore significant, so much so that it has become one of the metrics by which universities are judged in the Teaching Excellence Framework (TEF).[1]

This study adds to the literature on the impact of tuition fee reforms, and more generally the effect of debt aversion, on student outcomes. It also extends the literature on dropout behaviour which has primarily focused on high school students. Perhaps the main contribution of our paper, however, is that we attempt to explicitly separate the effect of the recession from that of the tuition fee reform. Our analysis combines duration analysis with difference-in-differences models, allowing us to exploit spatial and temporal variations in the unemployment rates at local labor market level. We use duration analysis because students can drop out at any point during the academic year, and there are financial incentives to terminate study before the end of their first semester and before the start of their second year of study (see Section 3.1). Duration analysis allows us to investigate if students responded to these incentives which would imply a non-monotonic hazard of dropping out of university. Employing standard linear models would only exploit the cross-sectional variation in dropout rates, and hence we would lose one important feature of our data. The use of duration analysis also enables us to control for the effects of unobserved student-level heterogeneity with respect to the decision to drop out.

In this analysis, the 'treatment' is assumed to be the severity of local unemployment, which is measured as a relatively large increase in the local travel-to-work area (TTWA) unemployment rate.[2] The local unemployment rate reflects the state of the local economy, particularly with respect to the availability of jobs and 'good' wage offers, and these conditions shape expectations of future labour market prospects, as well as the opportunity costs of education. The areas in the treated group are compared with those experiencing a relatively smaller increase in the unemployment rate (i.e. the control group). To ensure that the TTWAs have more similar 'initial conditions', we create two categories of TTWAs by distinguishing between areas with 'high' and areas with 'low' unemployment rates. Within each category we are able to define more homogenous treatment and control groups. This approach allows us to identify the causal effect of the Great Recession on the incidence and timing of dropout behaviour, insofar as we exploit the fact that the recession impacted local labour markets in a spatially uneven way. However, it is more difficult to identify a causal effect of the policy reform on student drop out behaviour because we do not have data on young people pre-enrolment, which means that we cannot model the decision of whether to go to university or not. If the decision to participate in HE is endogenous to the decision to subsequently drop-out, which is likely, then the effect of the policy reform on the drop out decision would be biased, therefore, we argue that our estimate of the policy reform is at best a conditional effect. Nevertheless, evaluating the effect of the policy reform, and disentangling this from the effect of the recession, is still instructive for policy makers and practitioners. Section 4.2 explains how we disentangle the reform effect from the recession effect. We also explore the issue of heterogeneity in the effects of the recession and of the reform by exploring variations between students from different

[1]The TEF was introduced in 2014 and is a metric based approach to the analysis of the quality of teaching delivered by universities. Metrics include the 1st year drop out rate, student satisfaction, the percentage of students entering graduate level jobs and the percentage of students gaining a 'good' degree. Each university is classified as either Gold, Silver or Bronze. Recently, the TEF has been extended to subject level.

[2]TTWAs are self-contained local labour markets, where by definition at least 70% of the population live and work in the area. TTWA boundaries are non-overlapping, are contiguous and cover the whole of the UK.

socio-economic backgrounds, the type of university attended and the subject studied. Our analysis is conducted separately for male and female students because previous research has shown that they differ in terms of educational aspirations and the risk of discrimination in the labour market.

We use administrative data collected by the Higher Education Statistics Agency (HESA) to analyse the dropout behaviour of university students. These data refer to the population of university students in the UK for the period 2004-2010, and we map information on unemployment rates at the TTWA level from the National Statistics Office. Our base, or naive, model estimates suggest that the policy reform increased the risk of dropout by 19 percent for males but had no effect for females, whereas the recession reduces the risk of drop out by around 30 percent. We also show that the hazard of dropout is not constant, tending to increase towards the end of the first year. A richer story emerges when we apply difference-in-differences methods and distinguish between students coming from 'high' versus 'low' unemployment areas.

Estimates show that in high unemployment areas the causal effect of the recession increases the risk of drop out by 13% for males and 9.5% for females, and is statistically significant for males but only marginally significant for females. The effect of the policy reform counteracted the recession effect for males, so reducing the risk of drop out by 3.5%, whereas for females the effect was positive (3.5%) and so reinforced the recession effect. The reform effects are smaller than the base case estimates and the causal effects of the recession. Interestingly, and contrary to expectations, in low unemployment areas, the recession also increased the risk of drop out for males by 32%, and this effect is larger than the equivalent effect for students from high unemployment areas, whereas for females the effect is negative (-5%) but statistically insignificant. This is as expected. The policy reform had small counteracting effects to the recession for males but was almost zero for females. Again this is as expected. In sum, males are more pessimistic about prospects in the labour market, especially those from low unemployment areas, or the opportunity costs of remaining in education are too high. Females from high unemployment areas appear to be more debt averse.

We also find that for students from poorer backgrounds the reform effect dominates the recession effect, increasing the risk of dropout, implying the presence of debt aversion. For students from teaching intensive universities both the reform effect and the recession effect are positive and so reinforce each other, implying that drop out behaviour is driven by a mixture of low expectations about labour market prospects post-graduation and debt aversion. Differences by subject of study are also observed. For students from high unemployment areas, the recession effect increases the risk of drop out for students in both STEM and Business, but it is only statistically significant for STEM. The reform effect counteracts the recession effect for STEM students but reinforces the recession effect for business studies students.

In the next section of this paper we review the recent literature on dropout behaviour. This is followed in Section 3 by a discussion of the evolution of the fee policy in England, and a detailed discussion of our data. We then outline our econometric modelling strategy in Section 4. The results of our analysis are presented in Section 5 which is followed by our conclusions and policy implications.

2 Literature and hypotheses

2.1 A review of the literature

Theoretical models of the decision to attend university or not, and the subsequent decision to drop out or not, are based on the solution to a series of optimisation problems that are well known in the literature (Ben-Porath, 1970; Heckman, 1976; Oreopoulos, 2007). Individuals maximise their

expected lifetime utility by choosing their level of education, conditional on the present value of the expected lifetime wealth. These models emphasise the importance of risk, or debt, aversion, and uncertainty about future labour market prospects, as well as other factors. The US literature has explored the effect of these factors most explicitly and we discuss the findings from this literature below, however, given our focus on UK university students we begin by describing the findings for the UK.

There are, in fact, very few studies of the decision to drop out of higher education in the UK, and most of the previous research is descriptive. Previous research has investigated the effects of family background, prior attainment, personal characteristics and the subject studied at university on drop out behaviour. For instance, Johnes and McNabb (2004) focused on drop outs from HE institutions in 1993, and investigates the role of student-course matches and the effect of the student's peer group. Although it is difficult with these data to mitigate the reflection problem (Manski, 1993), they do provide some descriptive evidence that males with low ability peers are more likely to drop out. Students in higher quality universities are less likely to drop out. Arulampalam et al. (2005) analyse the effect of prior qualifications, following eight cohorts of university entrants over the period 1984-1992. Perhaps unsurprisingly, weaker students are more likely to drop out. Females were less likely to drop out, and they confirm the negative effect of university quality on student drop out behaviour. Vignoles and Powdthavee (2009) assess the effect of socio-economic background using administrative data for 1st year students who enrolled at a university in 2004-05. Students from families of higher socio-economic status are less likely to drop out; interestingly, students from an ethnic minority background were also less likely to drop out. Although of less relevance to our paper, there are many more studies of drop out behaviour at the secondary school level. Lofstrom (2007), for instance, suggests that economic disadvantage, or family background, accounts for nearly 50% of the hispanics-whites gap in dropout rates. However, studies that use more sophisticated econometric techniques, such as Ermish and Francesconi (2001) and Bratti (2007), find a limited effect of family income on high school dropout behaviour.

There are several studies which explicitly examine the effect of tuition fee reforms in the UK. Dearden et al. (2014) evaluate the re-introduction of grants in the UK universities in 2004/05. Using a difference-in-differences approach they find that the increase in grants raised first-year degree participation (in 2005/06) by around 4 percentage points. Similarly, Azmat and Simion (2018) investigate the socio-economic impacts of the 2006 and 2012 tuition fee reforms on enrolments, relocation decisions, the type of institution to attend, as well as programme of study. They use HESA data linked to data from the National Pupil Database for the period 2004 to 2013. Interestingly, they find that the 2006 reform reduced overall enrolment at university by 1% but the decrease in the participation rate varied by socio-economic (income) groups. They find a larger negative effect for the highest socio-economic group (-1.6%), whereas for the medium and low socio-economic groups the effects were much smaller or neutral. Positive effects on enrolment of students from the lowest socio-economic groups have been found by Murphy et al. (2018). They show that after many years of widening socio-economic gaps in university participation, the gaps stabilised following the tuition fee reform, although the gap between the highest and lowest socio-economic groups was still large (i.e. 20 percentage points). Sá (2014) using a difference-in-differences approach investigates the impact of removing upfront tuition fees in Scotland in 2001 and the increase in fees in England in 2012. She shows that increasing fees reduces applications for programmes of study where labour market prospects are relatively poor post-graduation, that is, those with lower employment rates and wages. Her findings imply an absence of credit constraints insofar as the increase in fees in 2012 had a smaller effect on applications from poorer backgrounds and ethnic minorities. Crawford (2014) illustrates important socio-economic differences in dropout, degree completion and degree class for student from different family backgrounds, and she explains that they mainly reflect the

level of human capital of students when they start the university.

The effects of financial aid on college completion has also been investigated for other countries. For example Dynarski (2003) finds that the elimination of a student benefit programme reduced college attendance probabilities by more than a third. Linsenmeier et al. (2006) show that the introduction of mixed financial aid (loans and grants) has increased the enrolment rate of low-income minority students. However, Nielsen et al. (2010) using Danish data find that subsidies increase college enrolment but to a lesser extent compared to findings for the US. Arendt (2013) estimates duration models to estimate the effect on dropout of a Danish reform that increased student grants. He finds a reduction of around 50% in the probability of dropout for third and the fourth year students. Therefore, by implication, one might expect the introduction of the tuition fee reform, which has a prospect of higher student debt, may reduce university participation and increase the risk of drop out because of debt aversion.

Taylor and Rampino (2014), using data from the British Household Panel Survey, investigate the effect of the local unemployment rate on attitudes to education and the educational aspirations of young people at ages 11 and 15. They show that young people do take external labour market conditions into account when, for instance, considering whether to go to university. The effect varies by socio-economic background of the pupils, insofar as pupils whose parents are highly educated respond positively to poorer local labour market conditions, whereas the opposite is the case for pupils whose parents are less educated. Attitudes and aspirations with respect to university attendance also vary by gender, with girls being more positively disposed than boys. There is a small but growing literature which has attempted to uncover a causal effect on high school dropout behaviour. Higher rates of (youth) unemployment have been shown to increase the risk of dropping out of high school (Eckstein and Wolpin, 1999), whereas some studies show no effect (Warren and Lee, 2003; Mocetti, 2008). Tumino and Taylor (2015) analyse the effect of local labour market conditions on drop out rates from compulsory education at age 16, and explicitly consider the impact of credit constraints. They show that credit constrained young people, reflected by parental home ownership, are less likely to drop out at age 16. A one percentage point increase in local adult unemployment rate is correlated with a 2-4.2 percentage point increase in the risk of drop out at age 16. This implies that these young people are more sensitive to local labour market conditions than non-credit constrained young people. Very little work has been undertaken for university students, although Smith and Naylor (2001) using data for a single cohort of HE students in the UK who enrolled in 1989-90, do find a positive effect of unemployment on the risk of drop out. Adamopoulou and Tanzi (2017) study the effects of the Great Recession in Italy on university dropouts exploiting regional variations in adult and youth unemployment. They find a positive effect of adult unemployment on dropout whereas youth unemployment has a negative impact; the net effect of the recession is a reduction in the probability of dropping out.

Belfield et al. (2018) investigate variations in labour market outcomes for UK graduates, and argue that the decision of which university to attend and what programme to study are likely to be affected by those outcomes. They combine administrative data from the Longitudinal Education Outcomes dataset, which tracks students for 5 years after graduation, with HESA and other data. Their evidence shows, having controlled for student characteristics, wide variations in the rates of return to different degree subjects persist. The average student from a programme in medicine, maths and economics earns 20% more than the average graduate, which falls to 10% for business, computing and architecture graduates. The average creative arts graduate can expect to earn 15% less than the average graduate. There are gender variations by programme of study insofar as female graduates in medicine, pharmacology and English earn more than their male counterparts. Earnings prospects also vary by the type of institution attended, with graduates from Russell Group universities experiencing a significant earnings premium. Interestingly, employment rates

are highest for students from more teaching intensive universities. Other research has investigated the long term effects of graduating in a recession on mismatch earnings and the quality of jobs entered (Oreopoulos et al., 2012; Kahn, 2010; van den Berge, 2018).

Specifically with regards to debt aversion, Rothstein and Rouse (2011) show for the US how student debt can affect graduates employment decisions. They evaluate, in a very selective US college, the effects of the replacement of students loans with grant aid to students in financial need. They find that student debt reduces the probability of accepting low-paying jobs (e.g. in education, government and non-profit sectors) and an increased probability of accepting jobs with high starting salaries. Field (2009) offers a clear example of how psycho-social costs of debt can affect career decisions, by looking at the effects of an experiment run at the NYU School of Law. Students randomly selected in a lottery obtained income-contingent tuition fee waivers to be repaid only if after graduation they obtain a high-paying (private sector) job. Students not selected obtained tuition loans which were repaid by NYU if after graduation they decided to work in low-paying (public sector) jobs. Thus the two packages of financial aid were equivalent in terms of net present values and, according to the standard economic theory, students should have been indifferent to the lottery outcomes. However, Field finds that graduates that received the tuition fee waiver were more willing to work in low-paying jobs. This, they argue, can only be attributed to the different perception, and the associated psychological costs, of the debt horizon between the two financial packages.

These findings provide evidence that applicants, and most likely existing students, do consider labour market prospects post-graduation. These studies do not, however, investigate in detail the effect of the tuition fee reforms on the risk of drop out, and nor do they attempt to disentangle the effect of the reform from the effect of the Great Recession.

2.2 The expected effects of the policy reform and the recession on student drop out behaviour

Most of the previous research does not consider the underlying mechanisms which determine drop out behaviour, nor how these vary by student characteristics. The mechanisms behind the recession are: uncertainty about future labour market prospects, and the opportunity cost of education. The total effect on dropout behaviour is given by a combination of these effects. The mechanisms underlying the tuition fee reform are: debt aversion and liquidity constraints. An Income Contingent Loan (ICL) system, including loans and grants, provides liquidity and reduces the constraints compared to a mortgage loan system. However, the loan translates into a debt which has to be repaid once the student has a job and receives a wage above the earnings threshold. This may generate debt aversion, or a reluctance to borrow. It is also possible that there is a variation in student responses to the recession and tuition fee reform based on personal characteristics and whether they come from a high unemployment or a low unemployment area.

High unemployment areas. We expect that relatively higher levels of unemployment, as well as the larger increases in unemployment, creates considerable uncertainty about individual (and parental) labour market prospects, leading to a positive effect on dropout. However, a reduction in dropout rates arises because the opportunity costs of education fall. Depending on the magnitude of the effects arising through these mechanisms, the recession effect may be either positive or negative. The policy reform may reduce the probability of dropping out because of the reduction in the liquidity constraint provided by the ICL scheme. However, if students become more debt averse, which could ensue for those with weak academic performance or from poorer families, then the policy reform could increase the risk of dropout.

We expect a similar recession effect for males and females, but a different reform effect since females may be more debt averse given the existence of the gender wage gap in the labour market, hence increasing their dropout rate. For students from wealthier backgrounds we expect the recession effect on dropout to be negative, since they are supported by their parents and thus have a lower opportunity cost of education. The reform is also expected to reduce dropout, since liquidity and hence debt aversion are relatively minor issues, whereas for poorer students, the recession effect may still be negative, and counteracted by the reform effect. A deteriorating labour market generate a lack of liquidity at the household level, increasing students debt aversion, consequently increasing the risk of dropout. Negative effects on the risk of dropout are expected for the recession and the reform for students from research intensive universities, or study STEM/Business subjects, because rates of return are high. Students from teaching intensive (Other) universities are more likely to drop out, since uncertainty regarding labor market prospects may outweigh the opportunity cost of education. The policy reform may reinforce this effect by increasing debt aversion.

Low unemployment areas. The opportunity cost of education is higher for the students from low unemployment areas and it is likely to have a positive effect on the risk of dropout. However, they face less uncertainty regarding future labor market prospects, which may therefore reduce the risk of dropout. The reform effect may be positive if students are more debt averse, or negative due to the lack of liquidity constraints. We expect that the recession effect is smaller in magnitude compared to high unemployment areas, whereas the reform effect might be higher. Indeed, the decision to drop out are less related to the labor market conditions but more affected by debt aversion or reluctance to borrow. In terms of the different sub-groups of students, we expect the direction of the recession and reform effects to be the same as those for students in high unemployment areas but there are likely to be differences in magnitude.

3 Data and Institutional background

Students typically complete their compulsory schooling in England between the ages of 16 and 17, and then proceed onto further study for A-levels or vocational equivalents which permit entry to university. Universities set their own entrance requirements, and students select up to 5 universities they would prefer to attend. There is a centralised admissions system, provided by the Universities and Colleges Admissions System (UCAS) and all applications must be in the system by mid-January in the year in which they wish to go to university. A matching process then takes place from January where students are either rejected or made conditional offers of a place. However, the final decision on acceptance by a university is made following the publication of exam results in mid-August. For those students who fail to meet their conditional offers, they can enter a 'clearing and adjustment system', ultimately either matching with another university or failing to enter HE. Students can defer entry to university to acquire work experience and earn money to offset the costs of university attendance, a so-called 'gap year'. The imminent introduction of the tuition fee reform may have led some students to postpone the gap year or, as the previous literature suggests, some young people decide that the costs of university attendance outweigh the expected benefits and so avoid university completely. Section 3.2 explores these issues further.

3.1 The Evolution of tuition fee policy

A tuition fee was first introduced for students enrolling at universities in the UK in 1998/99 when they were required to pay approximately 1,000 GBP per annum. The Higher Education Reform Act, approved in 2004, which was effective from the academic year 2006/07, raised the cap on

fees to 3,000 GBP per annum in England. The 2006 reform represented a three-fold increase in tuition fees and was targeted at students whose nationality was English or Northern Irish. Fees at Scottish universities were unchanged, but English, Welsh and Northern Irish students studying in Scotland were liable for the fee increase. Scottish students studying in England were subject to the fee increase, whereas the tuition fee reform for students studying in Wales was introduced a year later in 2007, and a substantial scholarship or bursary was made available to these students. This increase applied equally to all universities and all undergraduate programmes. From 2006 students could defer the payment of fees by taking a Tuition Fee Income Contingent Loan (TICL) up to the maximum amount of fees being charged. Repayment of the loan was linked to income obtained after graduation, at a 9 per cent fixed interest rate for everything earned above 15,000 GBP and at a zero real interest rate. Hence, graduated students only repaid when they could afford it.[3] Nevertheless, students, parents and the wider public still perceive that students will leave university with considerable debt. In fact, Table 1 shows that in 2009, the year in which the first group of students on the TICL entered the labour market, only 128,100 students had reached the necessary threshold, out of 780,000, to repay the loan. However, the perception of high student debt was reinforced in 2012 when the government allowed universities to increase their fees to between 6,000-9,000 GDP per annum, with most universities charging 9,000 GDP.[4]

Students did receive financial support through both loans and grants. From 1999 support for living costs was entirely through Income Contingent Maintenance Loans (ICML), a quarter of which were means tested. Some students also received means tested tuition fee grants. In 2004/05, to help cover the cost of participating in higher education, the government introduced the Higher Education grant, and this was fully means tested and non-repayable. However, this grant was replaced from 2006/07 by the maintenance grant, which was a form of income-assessed support.[5] Living expenses whilst at university also potentially leads to debt accumulation throughout the academic year, and this may also affect the decision regarding when to drop out.

There are several aspects of the tuition fee loan repayment liability which should be highlighted. The first is that tuition fee loans were paid directly to the university at which the student was registered, however, for the period of our study if students dropped out before the 1st December in the first semester at university then no tuition fee was charged. If they dropped out after the 1st December but before the first payment from the Student Loan Company was received then they were charged pro-rata based on the number of weeks they had been in attendance. Similarly, if the students dropped out after the 1st February in their first year of study then they were liable for the first tranche of student fees.[6] The rules have changed since the introduction of a further fee increase in 2012. However, for students studying in Scotland, there is published advice which corroborates the previous approach to fee billing, as follows: 'Your Tuition Fee Loan will be paid directly to your university or college in one instalment, once they [the university] have confirmed you have [the student] registered on 1 December. If you [the student] withdraw before 1 December no Tuition Fee Loan will be paid' (Student Awards Agency Scotland, 2018). Students receive guidance about these rules in the terms and conditions of their contract supplied by the Student Loan Company, and their university will provide additional guidance. The second feature of the loan is the liability which accrued in three unequal instalments - 25% in Years 1 and 2 and the remaining 50% in

[3]Before 1998/99 loans were repaid on mortgage style basis.

[4]They also added a tapered rate of interest which would rise to 3% depending on earnings, and the earnings threshold at which the loans start to be repaid was increased from 15,000 to 21,000 GBP. This 'debt' will be written off after 30 years.

[5]In 2016 the maintenance grant was also replaced by a loan.

[6]This information was obtained from our Student Registry, who apply the rules in invoicing students, and their advice is that this was a system operated in the UK outside of Scotland.

Year 3. The Student Loan Company provides written guidance to students when taking out a loan and this specifically refers to this liability (Student Finance England, 2018). These features of the student loan may have provided incentives for students to drop out before December in the first year of study, or at the end of their first year, and consequently we might observe at least two spikes in the risk, or hazard, of dropping out of university. However, evidence has shown that students may be unaware of financial aid (Chan and Cochrane, 2008; Zarate and Pachon, 2006), and so it is feasible that students forget about the tuition fee liability rules. If that is the case then we might expect the hazard of dropping out to be flat. This is clearly an empirical issue that our methods of analysis allow us to investigate.

Table 1 shows the evolution of fees and student support from 2003 to 2009. We note that, although students could choose to pay fees up-front, the majority took out a tuition fee ICL from 2006.[7] The percentage of students eligible and on ICMLs has remained substantially unchanged (around 80%). The number of tuition fee grants drastically decreased from 2006 and they have been partially offset by maintenance grants.

3.2 Data and descriptives

We use administrative data which refers to the population of students who first enrolled at an institution of Higher Education in the UK between 2004-2010. The data were obtained from the Higher Education Statistics Agency (HESA) who had, in turn, obtained the data from each university and institute of higher education in the UK. There are several important features of these data. First, they record a student's start date and end date and hence allow us to calculate the duration of stay in education in days.[8] Second, the data contains personal information on age, ethnicity, gender, parental occupation, which corresponds to broad income status, as well as information on the university attended and programme of study. Third, since the data refer to the population of students there is no attrition which is a common problem in survey data. Finally, we are able to make use of repeated cohort data for students who enrolled in HE prior to the reform (2004-2005) and post-reform and recession (2006-2010) to investigate the hazard of exit from university.[9]

There are various restrictions that we impose on the data. Students who enrol at a university between 2004 and 2010 are included in the analysis, however, we restrict our attention to drop out behaviour amongst first year undergraduate students. This is because most drop out occurs in the first year of study, and we believe that the determinants of dropout behaviour are likely to vary by year of study. The first year of study is the period in which students learn most about their ability and either adjust, or not, to studying away from home.

Only full time students are considered since the dropout behaviour of part time students is very different - part time students have a higher propensity to drop out, possibly because of work or family reasons. Students who have been registered for 6 years or more are excluded. We also exclude students who register for an undergraduate course but who have a prior postgraduate qualification. These could have been data errors and where they are not, then they are likely to be ineligible for student loans. Students aged 36 years or more are excluded from the analysis, which

[7] Tuition fee ICL were also available to pre-2006/07 entrants if they made a full or partial contribution to their fixed fees, but we observe in Table 1 that the number of these loans are now negligible.

[8] We have analysed the end dates to ensure that they are not determined by administrative decisions of universities. Dropping out occurs throughout the year which does not support the idea of an administrative driven process - see also the baseline hazards in Figure 2.

[9] There are no publicly available data on dropouts by year of study, however, since we have population data we are able to calculate the percentage of dropout by year of study. For the period 2004 to 2010, 68% of dropouts did so in their first year, compared with 21% in year two. This demonstrates the importance of studying first year dropouts.

means that we control for mature students who may behave differently to the typical 18-19 year old entrant. Some universities place greater reliance on recruiting mature students, which provides further justification for their inclusion. Note, however, that the average age of the mature group (24.8 years) is still relatively young. We exclude EU and international students since they are either subject to a different fee regime or we do not have data on their home TTWA. Students studying in Wales are excluded because the policy reform started 1 year after that in England, and students studying in Scottish universities are also excluded because of the different fee regime. In sum, we retain UK students studying in English universities.

Using the students home postcode we map on to the student data a time series of unemployment rate data at the TTWA level.[10] The effect of neighbourhood on educational outcomes has been extensively researched, however, there is no literature that we are aware that considers whether individuals place a greater weight on the economic conditions where they are currently living (i.e at university) rather than where they used to live (i.e. at home). Our data do not identify the current residence, however, we argue that in our particular context, this may not be the most appropriate measure of local labour market conditions. For instance, a substantial number of English universities are located in inner city areas which students tend to cluster around to minimise costs of living. These areas are ones where local unemployment rates are relatively high. Also, a large proportion of first year university students live in campus halls, and so we would observe a substantial clustering of these students in these locations. Choosing the local labour market in which the student resides whilst at university may therefore mean that we obtain a biased estimate of the recession effect. Also, given that the majority of our sample are aged 18, this means that the proximity in time of the decision to attend university and leave their home labour market, implies that 1st year university students are more likely to behave like high school students. This is because these students will have far greater information about labour market conditions in their home area than they would about the local labour market which they reside on entry to university. Furthermore, a households experience of unemployment, which could influence the drop out decision of students, is clearly a function of the home labour market. Our unemployment data thus refer to total monthly unemployed claimants aged 18 years and over in the students home labour market. They reflect local economic conditions with respect to job opportunities and wages, impacting student expectations about the labour market prospects post-graduation.

To perform a duration analysis we need additional assumptions and restrictions. The survival time to dropout is clearly discrete, since the event of interest can happen on any day of the year. The time students become at risk of dropping out coincides with the start of the observation period. Censoring occurs at the end of the first academic year, which we assume to be the 31st of August. We also restrict the enrolment period to a twelve month time period and so the maximum length of our observation period is 365 days. We aggregate the duration in days into 12 periods of equal length i.e. 'monthly' intervals. Our final data set refers to over 1.8 million students.

Table 2, Panel A, reports the actual dropout rates by year (cohort) and gender. It is clear that, on average, the dropout rate has remained fairly constant at around 9 per cent of the student population up to 2008 when the drop out rate began to fall. Indeed, by 2010 the dropout rate was almost two thirds of the rate of 2004. Comparing the pre- and post-reform and recession periods, the drop out rate was around 1.4 percentage points lower in the post-reform and recession period. Panel A also shows that there are differences in drop out behaviour between male and female students - in the post-reform period the dropout rate for males falls slightly more (on average 1.6pp), compared to the pre-reform period, than for females (on average 1.3pp), but the absolute

[10]We exclude Scottish travel-to-work because a disproportionate number of them would be classified in the 'high' unemployment category, yet there are only 8% of Scottish students attending a university in England.

dropout rate for males is still higher than that for females in the post-reform and recession period.

Panel B disaggregates the dropout rate by the socio-economic background of the students' parents, where their occupation is collapsed into one of three groups - high, middle and low socio-economic groups.[11] These groups roughly correspond to high, middle and low income groups. What is clear from Panel B is that all groups exhibit a similar percentage point decline in the dropout rate following the policy reform and recession, even though there is still a clear ranking of dropout rates by socio-economic group for each year. The decrease in the dropout rate for the low income group is slightly higher from 2008, following the onset of recession, although this group still has the highest absolute dropout rate when compared with the middle and high income groups in the same period. The differences in drop out rates between income groups are between 1-2 percentage points. Taken together these findings do not suggest any major difference in student dropout behaviour between income groups.

The dropout rate for the broad type of university attended, classified here by the membership of various 'mission groups' is shown in Panel C. It is worth noting that UK HE is highly stratified and several 'mission' groups have emerged. The Russell Group of universities tend to be research intensive, are generally bigger in terms of student numbers and typically have a strong science base. Examples include Oxford, Cambridge, Imperial and UCL. The 1994 Group, which disbanded in 2013, focused on teaching and research and include universities such as, Lancaster and Sussex. Post-1992 universities which converted from polytechnic or college of higher education status are essentially teaching focused, and these make up the majority of our 'Other' category.[12] Not surprisingly, the type of students who attend universities in each of the mission groups vary in terms of prior educational attainment (e.g. A level scores) and, potentially, socio-economic background, the greatest overlap occurring between Russell and the 1994 Groups of Universities. It is important to allow for university type when trying to estimate the effect of the 2006 policy reform and recession on dropout behaviour.[13] We note that drop out rates are always higher in the 'Other' group of universities and lowest for Russell group universities (see Panel C). Nevertheless, the decrease in the dropout rate in the post-reform and recession period is greatest for the 'Other' group of universities (i.e. 1.8pp) and changes marginally for the 1994 Group of universities.

Panel D shows how dropout rates vary by broad subject of study, where the focus is upon STEM subjects and business studies. Drop out rates are approximately 1 percentage point higher for business studies students. This may reflect differences in rates of return in the labour market to different subject areas. Both subject areas witness a decrease in the dropout rate after 2006, however, when compared with the pre-reform and recession period, the decline is greatest from 2008 onwards when the recession effect kicks in.

It is possible that students behaved strategically in response to the tuition fee reform by deferring entry, switching the type of university that they wish to attend as well as the subject of study. Students may be more likely to seek those universities and subjects for which rates of return in the labour market are greatest (see Sá, 2014; Blom et al., 2015). Economic conditions also matter for this decision, as suggested in Section 2.2, however, in this paper we choose to focus on the impact of the Great Recession on drop out behaviour. It is clear from Panel B, Table 2, that there was a slight dip between 2004-2005 in the percentage of students enrolling at university from

[11]The high income group includes students whose parents have managerial and professional occupations. The middle income group includes students with parents in intermediate and technical occupations, small employers and self-employed. The low income groups includes student with parents in routine occupations and unemployed.

[12]This group of universities also includes some pre-1992 universities. Note that we also allow mission group membership to be time varying since some universities shifted from the 1994 Group to the Russell Group.

[13]Note that all universities are required to recruit students from poorer socio-economic backgrounds in an attempt to widen access to university. Some universities are more successful in attracting these students than others.

middle and low income backgrounds. Specifically, we observe a small decline (around 1 percent) in enrolments, for each income group, in 2006 when the policy reform was introduced. The high income group were worse affected. This picture is consistent with the evidence provided by the existing literature. Enrolments by income group pick up again after 2006. There is more evidence that the policy reform was associated with a switch in the type of university attended - the reduction in students attending 'Other' universities was offset by increased enrolments at Russell and 1994 Group universities. There is some evidence of falling enrolments into STEM at the time of the reform but in the period of the recession enrolments in business studies and STEM programmes increased.

Table B1, Appendix B, provides some descriptive statistics for the covariates used in our econometric analysis. In addition to the variables discussed above, we include information on country of domicile in the UK, ethnic background, and prior attainment. The latter is measured by a categorical variable which include quartiles of tariff score and lower or high qualifications in National Vocational Qualification (NVQ) equivalents.[14].

4 Econometric Methodology

Our interest is in the impact of the policy reform and recession on the incidence of, and time to, drop out in the first year of study. Given this, let M be the time in months to dropout, which can take integer values $m = 1, \ldots, M$ and consider a sample of N students ($i = 1, \ldots, N$). Define y_{im} as a dummy variable taking values 0 for all the periods a student i is enrolled at university and is censored at time M, and coded 1 in the period m when dropout occurs.

The conditional probability of dropping out for student i at period m, given that event has not yet occurred, is the discrete-time hazard

$$h_{im} = P[M_i = m | M > m-1, \mathbf{x_{im}}] \tag{1}$$

where $\mathbf{x_{im}}$ is a vector of observed explanatory variables, which can be time-variant or time-invariant.

Following Jenkins (1995), we expand the data to enable us to estimate discrete-time non-parametric hazard models. More precisely, we reorganize our pooled cross-sectional data in order to have multiple rows of observations for each individual student with as many rows as the periods at risk. Our final dataset has the format of an unbalanced panel. The likelihood for binary regression models based on the expanded dataset corresponds to the likelihood for the discrete-time hazard, and the predicted hazards are maximum likelihood estimates. We define the likelihood contribution for a student i who is censored at time M as the probability

$$P[M_i > m] = \prod_{m=1}^{M} (1 - h_{im}) \tag{2}$$

The likelihood contribution of a student who drops out in period M is

$$P[M_i = m] = h_{iM} \prod_{m=1}^{M-1} (1 - h_{im}) = \frac{h_{iM}}{1 - h_{iM}} \prod_{m=1}^{M} (1 - h_{im}) \tag{3}$$

[14]The UCAS tariff score is a value obtained assigning a numerical score to the possible grades that be can achieved in each type of all post-16 qualifications in the UK. Since the mechanism of computation of the tariff has been changed in 2007, we report in our analysis the quartiles of the tariff score distribution, to have a more homogenous measure over time. Furthermore, all the UK qualifications can be classified in NVQ equivalents, from a minimum level of 1 corresponding to primary education to NVQ 5 (post-graduate qualifications). In our sample we control for NVQ Level 2, which are secondary education qualifications, and NVQ Level 4, which are higher education qualifications

From Equations (2) and (3 the corresponding log-likelihood is

$$logL = \sum_{i=1}^{N}\sum_{m=1}^{M} y_{im}\, log(\frac{h_{im}}{1-h_{im}}) + \sum_{i=1}^{N}\sum_{m=1}^{M} log(1-h_{im}) \tag{4}$$

We now specify the form of the hazard function. The most common method for modelling covariate effects for continuous-time hazard data assumes proportionality.[15] As demonstrated by Prentice and Gloeckler (1978), the discrete-time counterpart of the proportional hazards model is the complementary log-log hazard rate.

$$c \log\log(h_{im}) = \log(-\log(1-h_{im})) = \mathbf{x_{im}}\beta + f(m) \tag{5}$$

where $f(m)$ is the baseline hazard. In our model we use a piecewise-constant function by including dummy variables for each period. Thus, within each monthly interval the duration dependence is assumed constant. We estimate the following semi-parametric, discrete-time, hazard model (our base model)

$$h_{imt} = 1 - \exp(-\exp(\mathbf{d_{im}}\alpha + \theta_1 R_t + \theta_2 U_{it}^w + \theta_3 R_t \times U_{it}^w + \mathbf{x_{im}}\beta)) \tag{6}$$

where $\mathbf{d}$ are the duration variables for the baseline hazard, w are the local labour markets, or more specifically TTWAs where student i is domiciled before enrolling at a university. U is the unemployment rate in the corresponding TTWA in the month of August before the start of academic year t. R is the policy reform dummy, such that:

$$R_t = \begin{cases} 1, & \text{if t <= 2005} \\ 0, & \text{if t >= 2006} \end{cases}$$

θ_3 is the coefficient of the interaction between policy reform and unemployment rate. It measures the variation in the conditional probability of drop out after the reform for different rates of unemployment in the TTWAs.

In our analysis, we generalize this model to account for any unobserved individual-specific effects. Ignoring unobserved heterogeneity can generate misleading inference due to inconsistent parameter estimators (Lancaster, 1992). In Equation (6) we therefore include a random intercept η_i, which is assumed to be uncorrelated with the vector of covariates, $\mathbf{x_{im}}$ (Narendranathan and Stewart, 1993).

$$h_{imt} = 1 - \exp(-\exp(\mathbf{d_{im}}\alpha + \theta_1 R_t + \theta_2 U_{it}^w + \theta_3 R_t \times U_{it}^w + \mathbf{x_{im}}\beta + \eta_i)) \tag{7}$$

This new specification requires an assumption on the the distribution of the unobservable individual-specific error term. Nicoletti and Rondinelli (2010) have provided Monte Carlo evidence that a misspecification of the random effect distribution does not bias either the duration dependence or the covariates included in the model.[16] We assume in all our estimations that the random intercept is normally distributed and constant over each time interval. For all models we cluster standard errors at the student level.

[15] This implies that the covariates act proportionally on the underlying hazard function.

[16] They also show more generally that discrete-time hazard models are robust to different forms of misspecification of the unobserved heterogeneity.

4.1 Identifying the effect of the recession

To identify the effect of the severity of the recession on dropout we focus on the years 2007 and 2009; 2007 is chosen because it is just prior to the recession in 2008 but follows the 2006 policy reform. From 2007 onwards, all students are subject to the ICL system and to the increased fee regime. The year 2009 is just after the recession.

Given the above, we first compute the mean of the unemployment rate for all TTWAs in 2007, and then look at the variation in the unemployment rate for each TTWA between 2007-2009. TTWAs are classified into one of two categories - those above the mean are 'high' unemployment areas, and those below the mean are 'low' unemployment areas. Then for each category of high and low unemployment areas we compute the percentile ranking of TTWAs, according to the percentage point change in their unemployment rate between 2007 and 2009. That ranking helps us to define in a transparent way our comparison groups, symmetrically for high and low unemployment areas. In the treatment group for each category we include the top 'n' TTWAs, that is, those with the largest increases in their unemployment rate over the period. In the control group for each category we select the bottom 'n' TTWAs with the lowest increases in their unemployment. Ideally, the control group should include students in TTWAs where the variation in the unemployment rate is zero (and hence completely unaffected by the recession), however, in practice, it is impossible to identify such a control group. The size of 'n' can be varied to enable us to test the sensitivity of our estimates. Initially, we select the top 25% of TTWAs for the treatment group and the bottom 25% for the control group for high and low unemployment areas.[17] We perform a sensitivity analysis where we restrict these percentages to 20% and then to 15% of TTWAs.

We therefore estimate the following semi-parametric, discrete-time, hazard model:

$$h_{mt} = 1 - \exp(-\exp(\mathbf{d_m}\alpha + \gamma_1 Y_t + \gamma_2 T + \gamma_3\, T \times Y_t + \mathbf{x_m}\beta)) \tag{8}$$

where t is the academic year, $m = 1, \ldots, M$ time in months to dropout,

$$Y_t = \begin{cases} 1, & \text{if t} = 2009 \\ 0, & \text{if t} = 2007 \end{cases}$$

$$T = \begin{cases} 1, & \text{if a student is in a treated TTWA} \\ 0, & \text{if a student is in a control TTWA} \end{cases}$$

γ_1 is a year effect for the students in all the TTWAs selected for the analysis, and corresponds to the naive before-after recession estimator. γ_2 captures the effect of the recession on the risk of dropout for students domiciled in a TTWA hit by relatively large increase in unemployment, when compared to TTWAs where the unemployment remained relatively stable. γ_3 is the difference-in-differences estimate which should identify an Average Treatment on the Treated (ATT) effect. This is the impact of the severity of the recession on the risk of dropout, for students enrolling at university between 2007 and 2009 and domiciled in TTWAs that suffered a relatively larger increase in unemployment. Equation 8 is estimated both for the high and the low unemployment categories.

[17] The number of TTWAs for the treated and control groups in high unemployment areas by region of the UK are: Wales (7), Yorkshire and Humberside (3); Northern (5); North West (6); South East (9); South Yorkshire (2); West Midlands (3); Northern Ireland (4); North East (3) and East Midlands (1). For low unemployment TTWAs the equivalent figures are: Wales (11); South East (16); North East (1); South West (12); East Midlands (4); North West (1); West Midlands (5); North Yorkshire (6) and the North (2).

4.2 Indirect effect of the tuition fee reform

In the Introduction, we discussed the fact that to properly identify the effect of the policy reform on dropout we need to observe the participation decisions of students at the end of secondary school, in order to control for a potential endogeneity bias. With our data we cannot evaluate students enrolment decisions, since we can only observe students that are already at university. Hence, a causal effect of the policy reform cannot be estimated. Nonetheless, in our analysis we can provide a conditional, and indirect, effect of the reform. This is derived by evaluating the treatment effect of the severity of unemployment on two partially overlapping sub-periods, where the only difference is assumed to be the introduction of the policy reform.

To obtain our estimate of the reform effect we adopt the same econometric approach explained in Section 4.1. We now define the treatment and control groups for the time period 2005-2009, which encompasses both the reform and the recession effects, and we estimate Equation 8. In this context, the coefficient γ_3 should pick up the effect on the risk of dropping out for students from TTWAs hit by a relatively large increase in the unemployment rate and enrolled at the university in 2009 under the new ICL repayment system. The coefficient γ_1 should measure a total time effect between 2005 and 2009. Summing up the coefficients γ_1 and γ_3 gives an estimate of a cumulative effect on dropout, which includes the effect of the change in the tuition fee regime and of the recession. We then sum up γ_1 and γ_3 using the estimates previously obtained from the estimation of Equation 8 for the period 2007-2009. The latter effect, as shown above, should then only include a cumulative recession effect. Finally, we compute the difference $(\gamma_1 + \gamma_3)^{(05-09)} - (\gamma_1 + \gamma_3)^{(07-09)}$, and we interpret it as an illustrative measure of the conditional reform effect on dropout, assuming that any other changes in student behaviour has remained constant over the period 2005-2009. We replicate this procedure for the high and the low unemployment categories.

4.3 Evaluation of Treatment and Control groups

The DiD analysis relies on one important assumption, that is, the presence of a common trend in dropout rates between the treated and the control group in the counterfactual situation of no treatment. This assumption cannot be formally tested, however, we report in Figure 1 the variation in the dropout rates for students living in the TTWAs included in our analysis and enrolled between 2004 and 2010. We show the trends for 'high' and 'low' unemployment areas, and we use for both cases as a reference category the year 2008, which corresponds to the beginning of the recession.[18] We can clearly see that in the pre-recession period (i.e. pre-treatment from 2004 to 2007), for both the treated and the control groups there is a constant positive variation of less than 2 per cent.[19] This evidence provides some confidence that the common trends assumption holds.

Table 3, Panel A, shows the number of TTWAs for each of the two time periods for high unemployment areas; Panel B reports the equivalent information for low unemployment areas. In each case, our selection of treatment and control groups gives a reasonably large number of TTWAs, which is reassuring since it implies that our findings can be generalised. Furthermore, we have checked the selected TTWAs to ensure that they are not highly spatially concentrated (see footnote 17, above) in terms of the treated and control groups, and these are geographically spread. We have also checked our choice of monthly unemployment rates and these are highly serially correlated as are the annual rates shown in Table 4. This implies that our findings are not likely to be sensitive to the choice of monthly or annual unemployment rate. Table B2 and B3 show the composition of the student body in both high and low unemployment areas, respectively.

[18] 2008 is chosen as the reference year because we seek to identify the causal effect of the recession.

[19] Note that the treatment is the severity of the recession, which affects all TTWAs but with different intensity.

We consider the samples for those TTWAs in the top and in the bottom 25% of the unemployment areas for 2005 and 2009. We do not observe any large differences in sample proportions over time, or for high and low unemployment areas. There is some difference over time with respect to the proportion of pupils from state-funded schools. A larger proportion of students from high income families and students whose ethnic background is 'white' are observed in low unemployment areas, however, there is still a reasonable proportion of students from low income backgrounds in these areas.

Panels A and B, in Table 3 also show the average dropout rates for high and low unemployment areas, disaggregated for treatment and control group. Focusing on Panel A, the dropout rates decrease by between around 1.5 and 2.7pp between 2005 and 2009, and the decline is greatest for the treatment group. We have computed the raw difference-in-differences, and for 2005 and 2009 this is reported in the final row of the Panel, and shows that for males the risk of dropout declined by a very small amount (-0.002) but increased slightly for females (0.005).[20] These raw effects should capture the recession effect confounded by the reform effect. Repeating the exercise for the post-reform/recession period (2007-09) shows that the dropout rate increased more for males than for females. These estimates should instead reflect only the recession effect. Differencing the two sub-periods leaves the possible biasing effect of the reform on the recession effect. This indirect reform effect suggests that the reduction in the risk of dropout for males was -1.4pp, which compares with a very small negative effect of -0.003 for females.

The effects for high unemployment areas are similar to the effects for low unemployment areas, except that the treated group experience the largest reductions in the risk of dropout between 2005-2009. There are differences between high and low unemployment areas with respect to the combined effects of the reform and the recession, especially with respect to females. In sum, the raw data suggests that we do observe differences in the effects of the recession (and policy reform) for high and low unemployment areas, as well as for males and females. Whether these effects persist once we control for covariates and unobserved heterogeneity remains to be seen.

5 Results

5.1 The effect of the policy reform and recession on the incidence and timing of dropping out - base model

In Table 5 we report the results of our base model estimated immediately before and after the policy reform. We include a full set of covariates together with the unemployment rate, reform and interaction effect variables for all students in all TTWAs. We only report models with unobserved heterogeneity (Equation 7), since the results for the homogenous models are almost identical.[21] The estimated effects on most of the covariates are signed appropriately and consistent with the existing literature. There are very few differences in the estimated effects for males and females, exceptions being the estimates for mature students and students from the Asian sub-group which suggest that females are less likely to drop out; for males the effects are positive. For both males and females, students with higher levels of prior attainment have a lower risk of drop out, however, females with a NVQ level 4 qualification are more likely to drop out. Male students studying creative subjects are less likely to drop out whereas in all other subjects the effects are positively signed.

[20] Note that these differences are not strictly comparable to our estimates below because they are simply means whereas the estimates from the econometric analysis are derived from a duration model and then converted to odds ratios.

[21] We also include the p-value of the likelihood ratio test of the hypothesis of zero unobserved heterogeneity. Unobserved heterogeneity does not appear to be an issue in these models.

Turning now to the variables of particular interest in this paper, we can see that the log odds ratios suggest that for males the tuition fee reform increased the risk of drop out by 19 percent, whereas for females the effect is positive but statistically insignificant. Similarly, students from TTWAs with higher unemployment rates were more likely to drop out, although again the effects are statistically insignificant for females. Also note that the effect of the unemployment rate is lower in this model than the effect of the policy reform. However, for male students the interaction effect between the unemployment rate and policy reform is negative and statistically significant, suggesting that in the post-reform period students from areas of higher unemployment were less likely to drop out; the effect for females is statistically insignificant. In sum, we observe different responses to the reform by male and female students which may reflect differences in their attitudes to debt or differences in labour market expectations. In Table 6 we restrict our analysis to the post-reform period and we focus on the years before and and after the recession. We observe a large recession effect which reduces the risk of dropping out by around 31% for males and 29% for females, respectively. The unemployment rate variable has a positive and statistically significant effect on the risk of dropping out, however, the interaction effect is not significant at conventional levels. Estimates for all of the other covariates show a similar pattern to that observed in Table 5, albeit with some differences in magnitudes.

To investigate further the effect of the policy reform and recession on the timing of the dropout decision we have re-estimated our models for the pre- and post-reform periods, 2004-05 and 2006-10 respectively. Figure 2 plots the estimated baseline hazards for the heterogeneous models, pre- and post-reform recession, and for females and males, respectively. There is very little difference between the estimated hazards in these two models. What is interesting, however, is that the hazard of exit from university increases slightly in the first three periods of study, and it is very similar pre- and post-reform recession, and then flattens off until period 8, after which it begins to increase again for the post-reform/recession period. This is followed by a further increase in the hazard in period 11.[22] Thus, although students could avoid the accumulation of debt if they leave university before December (i.e. by period 3) of the first semester, this part of the policy reform had little effect. This is possibly because students do not remember the rules. However, we do observe spikes towards the end of the first year, implying that there is a response in terms of dropout behaviour with respect to debt liability increasing from year 1 to year 2.

5.2 Preferred model - A difference-in-differences approach

In this section, we present estimates from a DiD approach where we identify the causal effect of the Great Recession on dropout behaviour, and the conditional effect of the policy reform. As explained in Section 4.2, the treatment is a measure of the severity of the recession in terms of its effect on the size of the change in local unemployment rates. Our results refer to the top 25% of TTWAs in terms of the change in the unemployment rate versus the bottom 25% of TTWAs, separately for high and low unemployment areas.

Table 7 reports the main results of this analysis for male and female students, separately.[23] We

[22]Students may decide to drop out before they inform the university, reflecting the learning process regarding their relative ability, and this may go some way to explaining the clustering of drop outs towards the end of our study period.

[23]We test for equality of the estimated effects between males and females, and between each of the sub-group in our heterogeneity analysis (see Section 5.3.2). This is not straightforward because our models are not nested. Nevertheless we employ the full sample, and we include in our main specification a triple interaction term to evaluate the effect on a given sub-group, for example Year×Treated×Gender. Our results suggests that there are in most cases statistically significant differences between the sub-groups, adding further justification to the separate analysis by sub-groups.

show the coefficients and standard errors for the key variables, as well as the associated odds ratios; we focus discussion on the odds ratios for the effect of the recession and the reform effect. Recall that holding everything else constant, the difference between the cumulative estimated effects of the reform and recession effects for 2005-2009 minus the cumulative effect for post reform period when the recession occurred, that is, 2007-2009, should provide a conditional effect of the policy reform.

Table 7, Panel A, focuses on high unemployment TTWAs. The interaction term Year×Treated, columns 2 and 4 (ignoring variable names), is the causal effect of the recession. It shows that in those TTWAs where unemployment increased by relatively more, there was a 13 and 9.5 percent rise in the risk of dropout, when compared to the control group, for males and females, respectively (see columns 2 and 4). The effect for males is statistically significant at the 10% level, whereas for females the estimated effect is marginally insignificant. With respect to the effect of the reform, for males we find that increasing tuition fees counteracts the recession effect reducing the risk of drop out by 3.5 percent, whereas for females the reform has a statistically significant and positive effect on the risk of drop out by 3.5 percent, so reinforcing the recession effect. The effects of the recession imply that these students are pessimistic about future labour market prospects, and this effect dominates the opportunity cost mechanism, especially for males. But, male students are less debt averse when compared to female students.

A different story emerges when looking at Panel B for the low unemployment areas. For students from these local labour markets, the causal effect of the recession increases the risk of drop out for males by 32 percent, whereas for females the recession led to a 5 percent reduction but the effect is statistically insignificant. The effect for males may arise because for these students the effect of a higher opportunity cost of education prevails over the future labour market prospects post-graduation. However, we do observe a small counteracting effect of the reform for males, reducing the risk of drop out by two percent, with an almost zero (slightly positive) effect for females. Overall, there is very little evidence of debt aversion for students from low unemployment areas. The difference in the effect of the policy reform for high versus low unemployment areas is consistent with predictions in Section 2.2.[24] In summary, the reform effects are typically smaller than the recession effects, and there are different behavioural responses to the reform for male and female students.

5.3 Sensitivity analysis and heterogeneity

5.3.1 A sensitivity analysis

In this section, we investigate the sensitivity of our estimated effects of the reform and of the recession to changes in the definition of the treatment and control groups. It is important to balance the choice of control and treatment group against the need to maintain a reasonable number of TTWAs in each group; the fewer TTWAs we select, the lower the number of dropouts that we observe. Nevertheless, to test the sensitivity of our estimated effects of the recession and of the reform we change the definition of how many TTWAs are in the treatment and the control groups

[24] We also conducted a sensitivity check where we use the youth unemployment rate to define the treatment and control groups. The recession effect generally changes sign but the reform effect remain positive but larger. We believe these results to be less plausible because, as we argued above, students are more likely to respond to aggregate labour market conditions than they are to the conditions in the youth labour market. Unemployed 16-24 year olds are more likely to be less skilled and less educated, and so university students will not see their circumstances as reflecting the labour market opportunities they may face regardless of whether they graduate or drop out. These results are available upon request.

for both high and low unemployment areas. For example, we restrict the treatment group to the top 20% worst performing TTWAs in terms of the percentage point change between 2007-2009 in the local unemployment rate, and the control group to the best 20% performing TTWAs. We observe the two groups separately for high and low unemployment areas. The the same selection process applies for the period 2005-2009.

Table B4 in the Appendix shows that the story is more or less consistent with that reported above in terms of the sign of the causal effect of the recession, however, there are differences in the magnitude of these effects. The recession effect is now positive for high and low unemployment areas, albeit smaller in magnitude when compared to our preferred set of estimates, except for the effect for males in low unemployment labour markets. The recession effects in Table B4 are also not well determined and only one is statistically significant. Interestingly, the reform effects are positive and statistically significant for students from high unemployment areas, implying the presence of debt aversion, whereas they are negative and statistically significant for students from low unemployment areas. Repeating the same exercise for the top 15 and bottom 15 TTWAs leads to a loss of statistical significance on the recession effect, whereas the reform effects retain their signs and statistical significance but the magnitude of the effects increases.[25] These sensitivity results imply that we have too few TTWAs as we go from 25% of TTWAs to 15% of TTWAs to give the necessary variation in the data to accurately measure the effects of the recession on drop out behaviour. There is also a concern about how generalisable our findings are when we use a smaller number of TTWAs. We therefore prefer the findings in Table 7.

5.3.2 Heterogeneity effects

Table 8 repeats the analysis for our preferred sample of TTWAs disaggregating by *socio-economic group*, since we argued in Section 2.2 that students of lower income families have different attitudes to the ICL.

Columns 2 and 4 report the causal effect of the recession. Our findings suggest that for students from high income backgrounds in high unemployment areas, the recession increased the risk of drop out by 20 percent, over twice that for students from low income backgrounds (Panel A). The latter effect is also statistically insignificant, and suggests that these students place greater weight on the lower opportunity costs of continued education. Our findings differ to those from Tumino and Taylor (2015), especially with respect to students from high income backgrounds, which is probably due to the fact that undergraduates are at a different stage in their life cycle when compared to 11-15 year olds. For students from a wealthier family background, the tuition fee reform reduced the risk of drop out by 8.8 percent, as expected, implying an absence of risk aversion, whereas for students from low income groups the reform increases the risk of drop out but the magnitude of the effect is very small. These socio-economic differences in dropout behaviour are consistent with the other behavioural differences observed in the existing literature. Furthermore, the reform effect nevertheless reinforces the recession effect for students from low income backgrounds, but counteracts it for students from high income backgrounds.

For low unemployment areas there is evidence of a causal effect of the recession, which increases the risk of drop out for students from high income backgrounds by 24 percent and it is statistically significant. This finding is contrary to expectations. The effect for students from low income backgrounds is positive, as suggested in Section 2.2, but statistically insignificant (see Panel B). The reform substantially reduces the risk of drop out for students from high income backgrounds (16 percent), whereas for students from low income backgrounds the tuition fee reform increases

[25] The results are available upon request.

the risk of dropout by 22 percent, suggesting the presence of substantial debt aversion. Thus, for students from high income backgrounds the recession effect is almost counterbalanced by the reform effect, leaving a small net positive effect on the risk of drop out, whereas for low income students the effects reinforce one another, implying a high positive effect. We conclude that students from low income groups living in low unemployment areas are more interested in exploiting the immediate returns in their local labor markets, and therefore see the prospect of additional debt as a burden. In contrast, students from high income backgrounds may have better access to job finding networks, hence the findings on the effect of the recession.

In Table 9 we report the findings for *university mission groups*. Recall that students from Russell Group universities face higher rates of return once in the labour market when compared to all other universities (Belfield et al, 2018). Also recall that the descriptive statistics show that students from Russell Group universities are less likely to drop out when compared with students from the 'Other' group of universities. Panel A of Table 9 shows that the recession had a substantial effect on the risk of drop out for students from research intensive universities (i.e. increasing this by 65.5 percent), and is contrary to expectations, whereas the effect for teaching intensive universities was a modest 1 percent increase. This latter effect is not well determined statistically. Since there is sorting of students on the basis of academic ability between the two types of universities, it is plausible that more highly qualified Russell Group university students from areas of high and rising unemployment see their labour market prospects post-graduation as being bleak and take their chances in the labour market and drop out of university. The effect of the reform reduces the risk of drop out by 27 percent, which is insufficient to fully counteract the recession effect, whereas for students from teaching intensive universities the tuition fee reform increases their risk of dropout by 8.7 percent, which drowns out the recession effect. These findings therefore also suggest that students who come from high unemployment areas, and who attend teaching intensive universities, are more debt averse.

Panel B of Table 9 shows that the effect for Russell Group universities is smaller (i.e. a 12.9 percent increase in the risk of drop out) in low unemployment areas, but this effect is statistically insignificant. This is to be expected because employment prospects are much better in low unemployment areas. There is a positive and statistically significant effect of the recession for teaching intensive universities, increasing the risk of drop out by 17.5 percent. The reform effect substantially counteracts the recession effect for students from research intensive universities, reducing the risk of drop out by 42 percent, implying an absence of debt aversion, whereas for students from teaching intensive universities the reform increases the risk of drop by 4.5 percent and so reinforces the recession effect. These students are therefore partly debt averse and partly sceptical about their labour market prospects.

We turn now to the discussion of broad *subject level* differences in drop out behaviour. Table 10, Panel A, reports the results for students who come from high unemployment areas. The recession increases the risk of drop out for students in both subject areas, however the effect is larger for STEM students (13.4 percent) than for business studies students, and the effect is statistically significant.[26] The reform effect reinforces the recession effect in the case of business studies subjects, whereas for STEM students the reform has a counteracting effect, reducing the risk of drop out by 5.7 percent. Although this effect is not large enough to offset the recession effect, it nevertheless implies that these students are less debt averse than their business studies counterparts. Interestingly, the recession has a positive but statistically insignificant effect for STEM and business studies students from low unemployment areas (Panel B), and the reform effect is negative and statistically significant but very small in magnitude in both cases. This suggests that these students are

[26]STEM refers to science, technology, engineering and mathematics subjects.

not debt averse and are not put off by the deteriorating conditions in their home labour markets, preferring instead to continue their studies in the hope of relative higher rates of return.

6 Conclusion

In this paper we investigate the effects of the so-called Great Recession, and the university tuition reforms, introduced in 2006, on the risk of students dropping out of HE in the UK. The key contribution of this paper is that we develop an approach to disentangle these two effects, and as such we add to previous research which have either found no effect of the 2006 tuition fee reform (Azmat and Simion, 2017), or positive effects in terms of reducing the participation gap between different socio-economic groups (Crawford, 2014; Murphy et al, 2018). We are able to identify the causal effects of the Great Recession, and the effect of the policy reform is given indirectly, conditional on student participation in Higher Education.

We use HESA data on first year students who enrolled at a university between 2004-2010. Duration modelling techniques are combined with a difference-in-differences approach. In our modelling, we define the comparison groups taking advantage of differences in the initial conditions in local labour markets, whilst also exploiting the fact that unemployment increased in a spatially uneven way. The treatment group includes those students from areas more severely hit by the recession, which is then compared with a control group, that is, students from areas where the effect of the recession was relatively mild.

Base model estimates suggest that the policy reform increased the risk of drop out by 19 percent for males but with no effect for females. When focusing on the recession effect only, we observe a reduction of the dropout rate by around 30 percent. These estimates are at best descriptive, however, these models do allow us to show that the hazard of drop out is not constant, tending to increase towards the end of the first year of study. Therefore, the financial incentives to drop out early following the introduction of the ICL do not appear to have impacted dramatically.

When we adopt a more rigorous difference-in-differences approach, our estimates show that for students from high unemployment areas, the causal effect of the recession increases the risk of drop out, especially for males. The effect of the tuition fee reform is small in magnitude and counteracts the recession effect for males, so reducing the risk of drop out, whereas for females the effect is positive and so reinforced the recession effect. Interestingly, for students from low unemployment areas, the recession also increases the risk of drop out for males, and is larger than the equivalent effect for students from high unemployment areas, suggesting that they place greater weigh on the 'higher' opportunity costs of education. For females the effect is negative but statistically insignificant. The policy reform had a small counteracting effects to the recession for males but there is almost no effect for females. These findings are broadly consistent with our expectations and indicates that males are less debt averse than females.

There is also heterogeneity in the effects of the recession and policy reform with respect to the socio-economic background of students, the type of university attended and subject studied.

The evidence presented in this paper has implications for current tuition fee policy and practice. From a policy perspective, it is clear that although the effect of the policy reform in 2006 was smaller than the recession effect, there were effects on drop out behaviour for certain sub-groups of students. These reform effects also vary in terms of the home labour market of the students. If we adopted our modelling approach to assess the 2012 reform, which increased fees further (to GBP 6,000-9,000), it is possible that a more substantial effect would emerge because perceived debt aversion would likely be greater. In terms of the implications for practice, our analysis raises interesting questions

with respect to the TEF, where first year drop out rates are an important metric, and with respect to the so-called widening participation agenda, through which central government has attempted to encourage universities to increase the participation and retention rates, especially of of students from lower socio-economic groups. Universities have responded by supporting students from poorer social backgrounds by providing scholarships and bursaries to reduce liquidity constraints even further. Our findings could help universities to more carefully target and monitor those students with a higher risk of drop out, and also suggest that universities need to look carefully at the external labour market environment that help to shape student expectations of the future.

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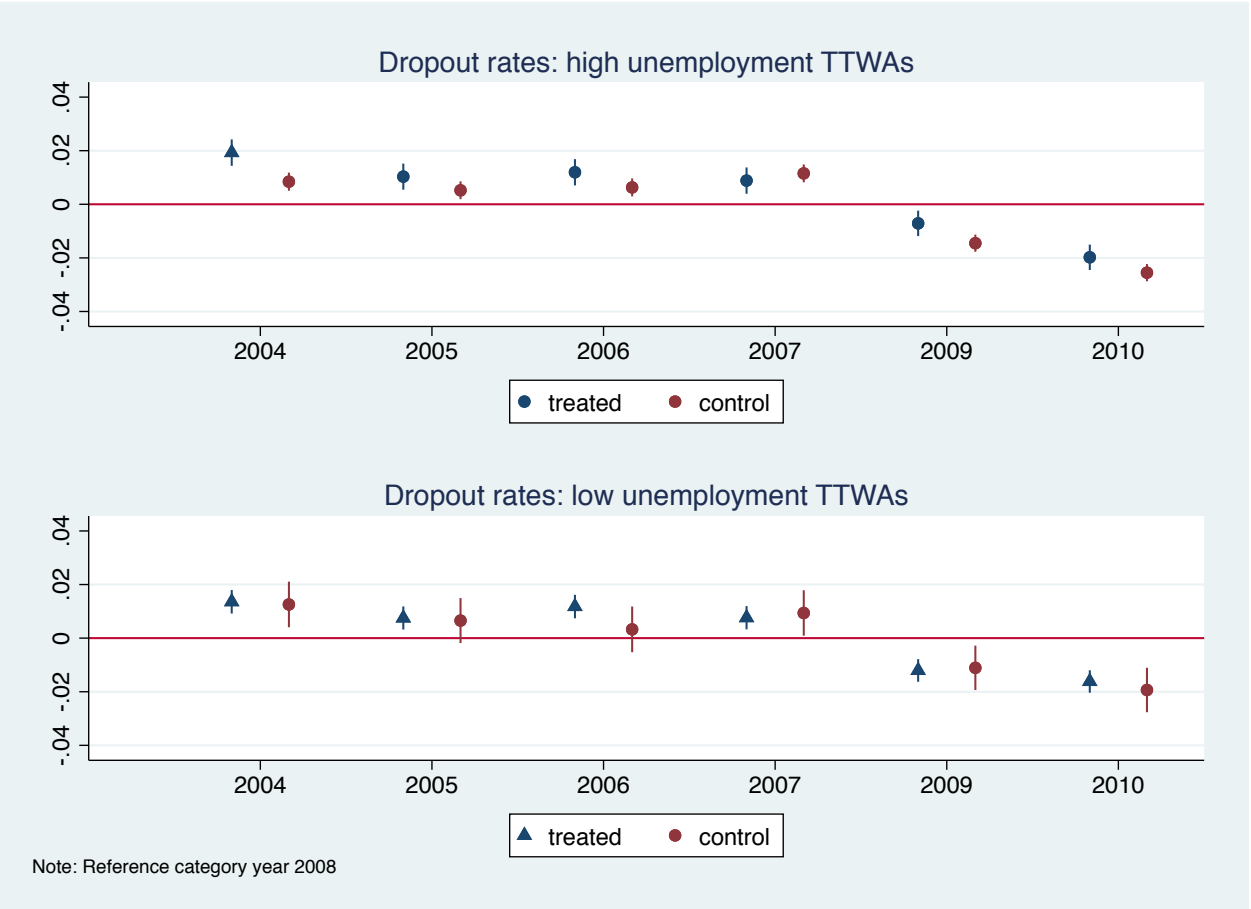
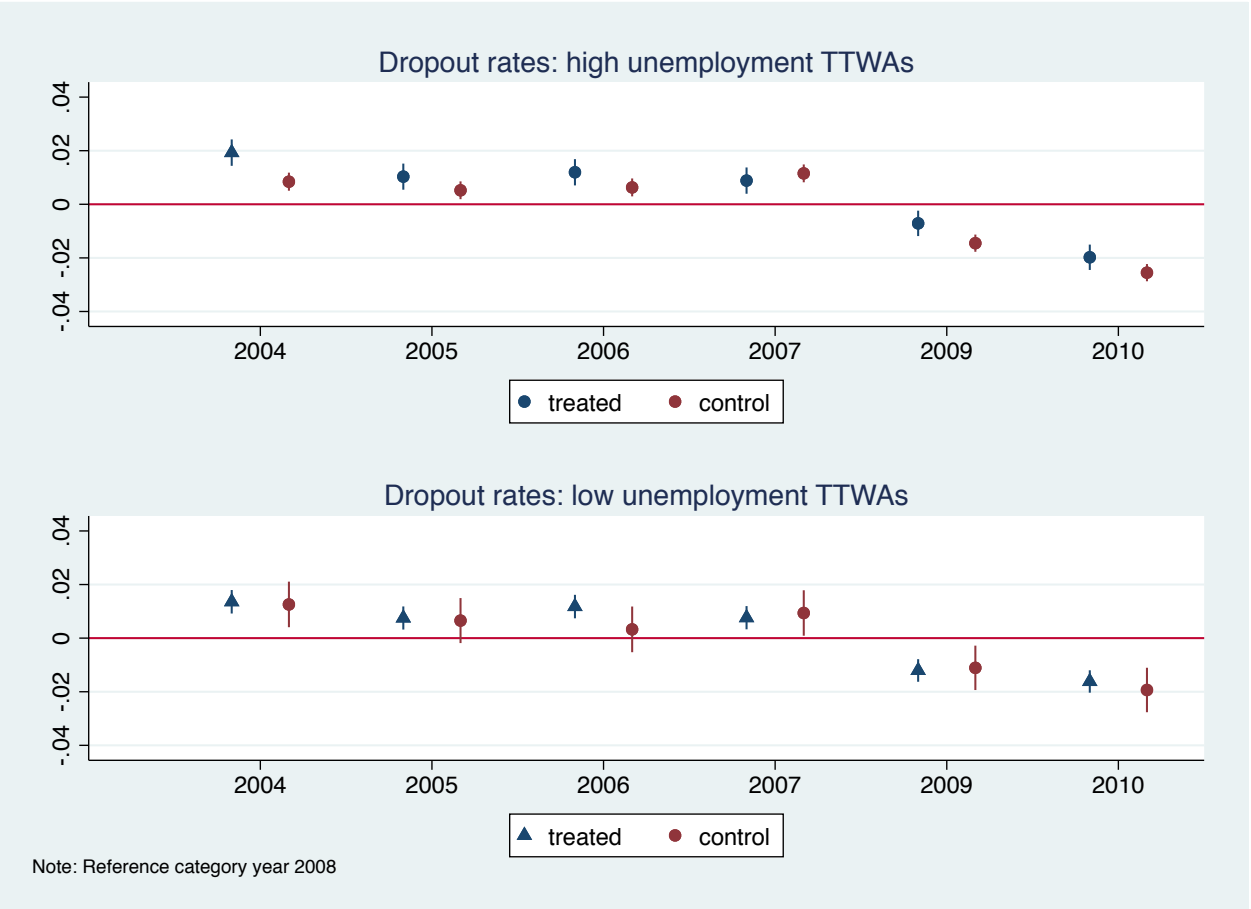
Figure 1: Assessing the common trend assumption: 2004-2010



Note: Reference category year 2008

Figure 2: Estimated hazard functions before and after the Policy Reform



Note: Reference category year 2008

Table 1: The evolution of the student financial support in the UK

	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
tuition fees	1125	1150	1175	3000	3070	3145	3225
Loans							
tuition fee loan:							
			students entering prior 2006/07				
number loans	na	na	na	158	99	32	5.6
			students entering from 2006/07				
number loans	na	na	na	234	455	666	780
maintenance loan:							
number eligible	840	874	897	905	928	963	1004
number loans	682	693	719	728	746	772	820
Borrowers above threshold (No.)	53.7	63.2	74.6	86.8	96.5	109.6	128.1
Grants							
tuition fee grant:							
number full grants	321	327	315	190	102	32	6.5
number partial grants	109	100	92	59	31	9	1.3
maintenance grant:							
full	na	na	na	98	180	155	99
partial	na	na	na	68	122	98	54
HE grants:							
full	na	83	160	127	77	24	5.2
partial	na	19	36	28	17	5	1

Source: Student Loans Company. Tuition fees are in GBP, other figures are in thousands.

na= not applicable.

Table 2: Analysis of dropout rates by year and characteristics

Panel A: Full sample and by gender

	pre-reform		*post-reform*				
	2004	2005	2006	2007	2008	2009	2010
All	0.089	0.086	0.089	0.087	0.077	0.065	0.054
N	281323	297762	287597	297016	317255	334538	339156
Males	0.097	0.093	0.094	0.092	0.082	0.072	0.061
N	126727	133390	128394	132229	141510	150028	152182
Females	0.084	0.081	0.084	0.084	0.073	0.060	0.049
N	154596	164372	159203	164787	175745	184510	186974

Panel B: Dropout rates by socio-economic background

	2004	2005	2006	2007	2008	2009	2010
High income	0.069	0.069	0.075	0.072	0.064	0.055	0.045
N	117176	113443	105606	109835	111375	122211	125536
%*	(14.6)	(14.1)	(13.1)	(13.6)	(13.8)	(15.2)	(15.6)
Middle income	0.082	0.081	0.083	0.083	0.073	0.065	0.055
N	54202	54676	51159	52732	56273	60423	60291
%	(13.9)	(14.0)	(13.1)	(13.5)	(14.4)	(15.5)	(15.5)
Low income	0.098	0.095	0.100	0.102	0.088	0.079	0.069
N	33739	36292	35101	37818	46075	42933	46391
%	(12.1)	(13.0)	(12.6)	(13.6)	(16.6)	(15.4)	(16.7)

Panel C: Dropout rates by type of university

	2004	2005	2006	2007	2008	2009	2010
Russell group	0.052	0.046	0.049	0.046	0.040	0.028	0.021
N	64463	64801	66064	68349	71074	71182	71144
%*	(13.5)	(13.6)	(13.8)	(14.3)	(14.9)	(14.9)	(14.9)
1994 group	0.072	0.064	0.075	0.074	0.062	0.052	0.044
N	32776	33037	34960	37496	39914	40114	40818
%*	(12.6)	(12.7)	(13.5)	(14.5)	(15.4)	(15.5)	(15.8)
Others	0.110	0.106	0.107	0.107	0.094	0.080	0.067
N	172751	188862	180060	184395	199481	216376	220765
%*	(12.7)	(13.9)	(13.2)	(13.5)	(14.6)	(15.9)	(16.2)

Panel D: Dropout rates by subject

	2004	2005	2006	2007	2008	2009	2010
Business	0.101	0.102	0.104	0.098	0.086	0.071	0.063
N	30634	31034	30852	32797	36121	37543	36922
%*	(13.0)	(13.2)	(13.1)	(13.9)	(15.3)	(15.9)	(15.7)
STEM	0.088	0.083	0.087	0.086	0.076	0.064	0.053
N	109912	114267	110803	116037	122801	132440	134698
%*	(13.1)	(13.6)	(13.2)	(13.8)	(14.6)	(15.7)	(16.0)

First year entrants only.

*Annual percentage of students enrolled over the 2004-2010 period.

Table 3: Dropout rates by high and low of unemployment areas - Top 25% versus bottom 25%

Panel A: Dropout rate in high unemployment areas

group	*year*	*males*	*females*	*TTWAs*	*year*	*males*	*females*	*TTWAs*
Treated	2005	0.106	0.087	22	2007	0.097	0.089	27
Treated	2009	0.087	0.071	22	2009	0.084	0.070	27
Control	2005	0.099	0.084	22	2007	0.107	0.090	22
Control	2009	0.082	0.063	22	2009	0.082	0.063	22

DiD: 2005/09		*DiD: 2007/09*		*Difference (2005/09)−(2007/09)*	
Males	*Females*	*Males*	*Females*	*Males*	*Females*
-0.002	0.005	0.012	0.008	-0.014	-0.003

Panel B: Dropout rate in low unemployment areas

group	*year*	*males*	*females*	*TTWAs*	*year*	*males*	*females*	*TTWAs*
Treated	2005	0.076	0.078	29	2007	0.078	0.083	30
Treated	2009	0.059	0.056	29	2009	0.063	0.056	30
Control	2005	0.080	0.076	30	2007	0.084	0.073	33
Control	2009	0.062	0.059	30	2009	0.054	0.058	33

DiD: 2005/09		*DiD: 2007/09*		*Difference (2005/09)−(2007/09)*	
Males	*Females*	*Males*	*Females*	*Males*	*Females*
0.001	-0.005	0.015	-0.012	-0.014	0.007

Note: sample of 1st year entrants in English universities.

Table 4: Correlations between unemployment rates

	Aug05	Aug06	Aug07	Aug08	Aug09	Aug10	Aug11
Aug05	1						
Aug06	0.970***	1					
Aug07	0.943***	0.972***	1				
Aug08	0.925***	0.953***	0.976***	1			
Aug09	0.840***	0.873***	0.903***	0.950***	1		
Aug10	0.894***	0.899***	0.910***	0.946***	0.960***	1	
Aug11	0.896***	0.906***	0.917***	0.955***	0.960***	0.985***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Estimates of the determinants of dropout behaviour - 2005 vs 2006 - Reform effect

	Males Heterogenous	*Females Heterogenous*
Policy Reform	0.172***	0.048
	(0.054)	(0.049)
log odds ratio	1.188***	1.050
unemployment rate	0.081***	0.015
	(0.015)	(0.014)
log odds ratio	1.084***	1.015
Ref×unemp	-0.042**	0.013
	(0.021)	(0.019)
log odds ratio	0.959**	1.013
Country of origin		
Scotland	-0.070	-0.197
	(0.138)	(0.136)
Wales	0.151**	0.171***
	(0.060)	(0.052)
N.Ireland	0.251***	0.219***
	(0.081)	(0.071)
Socio-economic background		
Middle income family	0.010	-0.008
	(0.026)	(0.023)
Low income family	0.100***	0.090***
	(0.030)	(0.026)
Ethnic background		
Black	0.112**	-0.128***
	(0.048)	(0.047)
Asian	0.120***	-0.210***
	(0.029)	(0.031)
Other/Unknown	0.179***	0.072**
	(0.036)	(0.036)
Prior Attainment / school		
1st quartile of tariff score	-0.156***	0.030
	(0.037)	(0.036)
2nd quartile	-0.387***	-0.210***
	(0.040)	(0.038)
3rd quartile	-0.696***	-0.450***
	(0.044)	(0.040)
4th quartile	-1.197***	-0.803***
	(0.051)	(0.045)
NVQ Level 4	-0.031	0.082*
	(0.042)	(0.043)
Privately funded school	0.008	-0.082**
	(0.034)	(0.035)
Other school type	0.172***	0.169***
	(0.030)	(0.029)
Mature student	0.020	-0.133***
	(0.032)	(0.033)
Type of University		
1994 group	0.216***	0.113***
	(0.037)	(0.035)
Other universities	0.408***	0.306***
	(0.033)	(0.029)
Subject of study		
physical sciences	0.151***	0.084**
	(0.030)	(0.038)
social sciences	0.082***	0.162***
	(0.031)	(0.026)
humanities	0.021	0.120***
	(0.031)	(0.023)
creative sciences	-0.151***	0.040
	(0.034)	(0.028)
N×m	1634255	2073482
LogL	-64320.49	-79426.31
$\chi^2_{p-value}$	0.035	0.041

First year entrants only, in English universities.
$\chi^2_{p-value}$ of LR test of model with Normal distributed heterogeneity against model without controlling for heterogeneity.
Base category prior attainment: NVQ Level 2.
Base category subject: medical sciences.

Table 6: Estimates of the determinants of dropout behavior - 2007 vs 2009 - Recession effect

	Males Heterogenous	*Females Heterogenous*
Recession	-0.345***	-0.339***
	(0.064)	(0.058)
log odds ratio	0.689	0.712
unemployment rate	0.091***	0 .062***
	(0.016)	(0.015)
log odds ratio	1.095	1.064
Recess×unemp	-0.009	-0.019
	(0.021)	(0.018)
log odds ratio	0.990	0.980
Country of origin		
Scotland	-0.063	0.008
	(0.150)	(0.139)
Wales	0.170**	0.163***
	(0.068)	(0.061)
N.Ireland	0.136	0.209***
	(0.087)	(0.074)
Socio-economic background		
Middle income family	0.052*	0.020
	(0.027)	(0.024)
Low income family	0.139***	0.126***
	(0.031)	(0.027)
Ethnic background		
Black	0.149***	-0.008
	(0.047)	(0.044)
Asian	0.043	-0.287***
	(0.032)	(0.034)
Other/Unknown	0.187***	0.160***
	(0.038)	(0.036)
Prior Attainment / school		
1st quartile of tariff score	-0.025	0.147***
	(0.040)	(0.039)
2nd quartile	-0.259***	-0.099**
	(0.044)	(0.041)
3rd quartile	-0.582***	-0.336***
	(0.049)	(0.044)
4th quartile	-1.006***	-0.622***
	(0.056)	(0.049)
NVQ Level 4	0.149***	0.225***
	(0.045)	(0.047)
Privately funded school	-0.067*	-0.134***
	(0.037)	(0.037)
Other school type	0.152***	0.136***
	(0.037)	(0.037)
Mature student	0.147***	-0.084**
	(0.035)	(0.038)
Type of University		
1994 group	0.268***	0.338***
	(0.040)	(0.036)
Other universities	0.525***	0.416***
	(0.037)	(0.032)
Subject of study		
physical sciences	0.204***	0.114***
	(0.032)	(0.039)
social sciences	0.049	0.111***
	(0.033)	(0.027)
humanities	0.102***	0.086***
	(0.032)	(0.024)
creative sciences	0.030	0.048
	(0.035)	(0.030)
N×m	1,663,930	2,135,587
LogL	-58353.60	-72941.767
$\chi^2_{p-value}$	0.408	0.455

First year entrants only, in English universities.
$\chi^2_{p-value}$ of LR test of model with Normal distributed heterogeneity against model without controlling for heterogeneity.
Base category subject: medical sciences.

Table 7: Effect of the reform and the recession (2007-09) by low and high of unemployment areas - Top 25% versus bottom 25%

Panel A: High Unemployment areas				
	Males		*Females*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.195***	-0.253***	-0.320***	-0.340***
	(0.040)	(0.040)	(0.039)	(0.038)
log odds ratio	0.823	0.777	0.726	0.711
Treated	0.247***	0.047	0.128***	0.103**
	(0.046)	(0.046)	(0.044)	(0.041)
log odds ratio	1.280	1.048	1.137	1.109
Year×Treated	0.030	0.123*	0.105*	0.091
	(0.065)	(0.063)	(0.061)	(0.058)
log odds ratio	1.031	1.130	1.111	1.095
N	570617	605924	728396	787896
LogL	-23098.27	-24000.21	-26536.85	-28743.87
Indirect Reform Effect[a]				
	Males		*Females*	
(2005-09)-(2007-09)	-0.035***		0.035***	
	0.000		0.000	
log odds	0.966		1.0355	
Panel B: Low Unemployment areas				
	Males		*Females*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.241**	-0.465***	-0.294***	-0.286***
	(0.113)	(0.099)	(0.100)	(0.089)
log odds ratio	0.786	0.628	0.746	0.751
Treated	-0.094	-0.172**	-0.022	0.048
	(0.087)	(0.076)	(0.074)	(0.069)
log odds ratio	0.911	0.842	0.978	1.049
Year×Treated	0.032	0.277**	-0.043	-0.052
	(0.128)	(0.115)	(0.112)	(0.102)
log odds ratio	1.032	1.319	0.958	0.949
N	268431	299151	336002	372816
LogL	-8611.496	-9639.763	-11394.82	-12773.63
Indirect Reform Effect[a]				
	Males		*Females*	
(2005-09)-(2007-09)	-0.021***		0.002***	
	0.001		0.000	
log odds ratio	0.980		1.002	

First year entrants only in English universities.
All models contain the same control variables as in the base model.
Recession effect columns 2 and 4.
[a] $(\text{Year+Interaction})_{2005/09} - (\text{Year+Interaction})_{2007/09}$

Table 8: Effect of the reform and the recession (2007-09) by low and high of unemployment areas and by socio-economic status - Top 25% versus bottom 25%.

Panel A: High Unemployment areas				
	High Income		*Low Income*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.385***	-0.368***	-0.274***	-0.247***
	(0.048)	(0.048)	(0.072)	(0.070)
log odds ratio	0.680	0.692	0.761	0.781
Treated	0.225***	0.127**	0.162**	0.085
	(0.053)	(0.052)	(0.080)	(0.074)
log odds ratio	1.252	1.136	1.176	1.089
Year×Treated	0.110	0.181**	0.114	0.084
	(0.075)	(0.072)	(0.108)	(0.102)
log odds ratio	1.117	1.199	1.120	1.088
N	546364	597412	181980	205259
LogL	-17693.95	-18786.3	-7897.432	-8757.596
Indirect Reform Effect[a]				
	High Income		*Low Income*	
(2005-09)-(2007-09)	-0.088***		0.003***	
	0.000		0.001	
log odds	0.916		1.003	
Panel B: Low Unemployment areas				
	High Income		*Low Income*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.504***	-0.444***	-0.134	-0.450**
	(0.117)	(0.099)	(0.209)	(0.175)
log odds ratio	0.604	0.641	0.875	0.638
Treated	-0.163*	-0.120	0.045	-0.115
	(0.086)	(0.076)	(0.162)	(0.134)
log odds ratio	0.850	0.887	1.046	0.891
Year×Treated	0.099	0.219*	-0.057	0.058
	(0.132)	(0.115)	(0.230)	(0.200)
log odds ratio	1.104	1.244	0.944	1.059
N	294627	337439	73752	79328
LogL	-8511.549	-9784.802	-2835.041	-3264.462
Indirect Reform Effect[a]				
	High Income		*Low Income*	
(2005-09)-(2007-09)	-0.179***		0.201***	
	0.001		0.002	
log odds ratio	0.836		1.222	

First year entrants only in English universities.
All models contain the same control variables as in the base model.
Recession effect columns 2 and 4.
[a] $(\text{Year+Interaction})_{2005/09} - (\text{Year+Interaction})_{2007/09}$

Table 9: Effect of the reform and the recession (2007-09) by low and high of unemployment areas and by university type - Top 25% versus bottom 25%

Panel A: High Unemployment areas				
	Russell Group		*Other Universities*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.508***	-0.513***	-0.225***	-0.227***
	(0.091)	(0.087)	(0.031)	(0.032)
log odds ratio	0.601	0.599	0.799	0.797
Treated	0.404***	0.042	0.115***	0.110***
	(0.088)	(0.089)	(0.036)	(0.035)
log odds ratio	1.499	1.043	1.122	1.116
Year×Treated	0.174	0.504***	0.089*	0.009
	(0.132)	(0.128)	(0.050)	(0.048)
log odds ratio	1.191	1.655	1.094	1.009
N	305998	349534	813553	843508
LogL	-6168.878	-6994.135	-38257.68	-39500.48

Indirect Reform Effect[a]		
	Russell Group	*Other Universities*
(2005-09)-(2007-09)	-0.324***	0.083***
	0.001	0.000
log odds	0.723	1.087

Panel B: Low Unemployment areas				
	Russell Group		*Other Universities*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.258	-0.264	-0.297***	-0.416***
	(0.216)	(0.166)	(0.085)	(0.078)
log odds ratio	0.772	0.768	0.743	0.660
Treated	0.285*	-0.143	-0.125*	-0.083
	(0.160)	(0.133)	(0.064)	(0.060)
log odds ratio	1.330	0.867	0.883	0.921
Year×Treated	-0.415*	0.122	0.086	0.161*
	(0.243)	(0.201)	(0.096)	(0.089)
log odds ratio	0.660	1.129	1.090	1.175
N	144539	180617	367635	383190
LogL	-2801.201	-3473.537	-14825.18	-16122.09

Indirect Reform Effect[a]		
	Russell Group	*Other Universities*
(2005-09)-(2007-09)	-0.531***	0.044***
	0.001	0.000
log odds ratio	0.588	1.045

First year entrants only in English universities.
All models contain the same control variables as in the base model.
Recession effect columns 2 and 4.
[a] $(\text{Year+Interaction})_{2005/09} - (\text{Year+Interaction})_{2007/09}$

Table 10: Effect of the reform and the recession (2007-09) by business and stem - Top 25% versus bottom 25%

Panel A: High Unemployment areas				
	Business		*STEM*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.242***	-0.274***	-0.244***	-0.305***
	(0.077)	(0.078)	(0.048)	(0.047)
log odds ratio	0.785	0.760	0.783	0.737
Treated	0.082	0.061	0.239***	0.052
	(0.100)	(0.094)	(0.054)	(0.051)
log odds ratio	1.085	1.063	1.270	1.053
Year×Treated	0.072	0.063	0.006	0.126*
	(0.143)	(0.131)	(0.075)	(0.071)
log odds ratio	1.075	1.066	1.006	1.134
N	123509	128445	468816	517984
LogL	-5382.671	-5759.145	-17081.73	-18640.46

Indirect Reform Effect[a]		
	Business	*STEM*
(2005-09)-(2007-09)	0.041***	-0.059***
	0.002	0.000
log odds	1.042	0.943

Panel B: Low Unemployment areas				
	Business		*STEM*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.481*	-0.541**	-0.161	-0.340***
	(0.278)	(0.249)	(0.134)	(0.113)
log odds ratio	0.618	0.582	0.851	0.712
Treated	-0.061	0.104	0.125	-0.100
	(0.201)	(0.182)	(0.102)	(0.088)
log odds ratio	0.941	1.110	1.133	0.905
Year×Treated	0.187	0.259	-0.120	0.061
	(0.305)	(0.277)	(0.150)	(0.132)
log odds ratio	1.205	1.295	0.887	1.063
N	45123	49500	221502	249186
LogL	-1788.492	-1918.477	-6732.689	-7376.356

Indirect Reform Effect[a]		
	Business	*STEM*
(2005-09)-(2007-09)	-0.012***	-0.001
	0.003	0.001
log odds ratio	0.988	0.999

First year entrants only in English universities.
All models contain the same control variables as in the base model.
Recession effect columns 2 and 4.
[a] $(\text{Year+Interaction})_{2005/09} - (\text{Year+Interaction})_{2007/09}$

Table B1: Descriptive Statistics - Sample proportions

	Mean	*Std. Dev.*
male	0.442	0.497
female	0.558	0.497
English	0.956	0.205
Scottish	0.005	0.074
Welsh	0.02	0.139
Northern Ireland	0.01	0.098
White	0.753	0.432
Black	0.06	0.237
Asian	0.114	0.317
Other/Unknown	0.064	0.246
high income family	0.415	0.493
middle income family	0.2	0.4
low income family	0.147	0.354
NVQ Level 2 and below	0.068	0.251
NVQ Level 4	0.059	0.236
1st quartile tariff score	0.252	0.434
2nd quartile tariff score	0.206	0.405
3rd quartile tariff score	0.212	0.409
4th quartile tariff score	0.203	0.402
State-funded school or college	0.792	0.406
Privately funded school	0.106	0.308
mature	0.147	0.354
Rusell group	0.223	0.416
1994 Group	0.144	0.351
Other universities	0.633	0.482
Medical sciences	0.224	0.417
Physical sciences	0.154	0.361
Social sciences	0.204	0.403
Humanities	0.268	0.443
Creative sciences	0.151	0.358

First year entrants only in English universities.
Level 2 and below refer to students with less than A-level.
NVQ level 4 refers to students with a qualification higher than A-level.
Family income categories exclude unclassified.
Tariff score is a measure of prior attainment.

Table B2: Descriptive Statistics - Top 25% versus bottom 25% - high unemployment

	2005		*2009*	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*
male	.445	.497	.442	.497
female	.555	.497	.558	.497
English	.932	.252	.931	.253
Scottish	.007	.082	.007	.081
Welsh	.045	.207	.046	.209
Northern Ireland	.016	.125	.017	.127
White	.670	.470	.656	.475
Black	.097	.296	.115	.319
Asian	.151	.358	.146	.353
Other/Unknown	.082	.275	.083	.276
high income family	.375	.484	.384	.486
middle income family	.203	.402	.204	.403
low income family	.140	.347	.154	.361
Level 2 and below	.068	.252	.074	.262
NVQ Level 4	.069	.253	.065	.247
1st quartile tariff score	.222	.416	.230	.421
2nd quartile tariff score	.215	.411	.207	.405
3rd quartile tariff score	.227	.419	.223	.416
4th quartile tariff score	.199	.399	.200	.400
State-funded school or college	.755	.430	.823	.382
Privately funded school	.108	.310	.101	.301
mature	.164	.370	.154	.361
Rusell group	.202	.401	.192	.394
1994 Group	.118	.323	.126	.332
Other universities	.680	.466	.681	.466
Medical sciences	.215	.411	.228	.420
Physical sciences	.156	.362	.159	.365
Social sciences	.211	.408	.221	.415
Humanities	.272	.445	.254	.435
Creative sciences	.147	.354	.138	.345

See Notes Table B1.

Table B3: Descriptive Statistics - Top 25% versus bottom 25% - low unemployment

	2005		*2009*	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*
male	.436	.496	.445	.497
female	.564	.496	.555	.497
English	.907	.291	.905	.293
Scottish	.008	.087	.008	.089
Welsh	.085	.28	.087	.282
White	.900	.299	.895	.306
Black	.014	.117	.021	.143
Asian	.041	.198	.043	.202
Other/Unknown	.045	.207	.041	.198
high income family	.456	.498	.461	.498
middle income family	.206	.405	.21	.407
low income family	.125	.331	.132	.339
Level 2 and below	.055	.227	.064	.245
NVQ Level 4	.046	.209	.045	.208
1st quartile tariff score	.235	.424	.235	.424
2nd quartile tariff score	.223	.416	.221	.415
3rd quartile tariff score	.215	.411	.230	.421
4th quartile tariff score	.226	.418	.203	.403
State-funded school or college	.771	.420	.851	.356
Privately funded school	.114	.317	.107	.309
mature	.126	.332	.119	.323
Russell group	.220	.414	.207	.405
1994 Group	.139	.346	.139	.346
Other universities	.641	.48	.658	.474
Medical sciences	.218	.413	.227	.419
Physical sciences	.156	.363	.157	.364
Social sciences	.177	.382	.184	.387
Humanities	.284	.451	.269	.443
Creative sciences	.164	.371	.164	.37

See Notes Table B1.

Table B4: Effect of the reform and the recession (2007-09) by low and high of unemployment areas - Top 20% versus bottom 20%

Panel A: High Unemployment areas				
	Males		*Females*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.212***	-0.244***	-0.302***	-0.347***
	(0.042)	(0.042)	(0.041)	(0.041)
log odds ratio	0.809	0.784	0.740	0.707
Treated	0.200***	0.012	0.119**	0.074
	(0.051)	(0.066)	(0.049)	(0.058)
log odds ratio	1.222	1.012	1.127	1.077
Year×Treated	0.030	0.038	0.063	0.038
	(0.072)	(0.087)	(0.068)	(0.078)
log odds ratio	1.031	1.039	1.065	1.038
N	495023	435505	634163	559825
LogL	-19864.01	-16931.05	-22631.44	-19833.87
Indirect Reform Effect[a]				
	Males		*Females*	
(2005-09)-(2007-09)	0.025***		0.071***	
	0.000		0.000	
log odds	1.025		1.073	

Panel B: Low Unemployment areas				
	Males		*Females*	
	2005-2009	*2007-2009*	*2005-2009*	*2007-2009*
Year	-0.207*	-0.493***	-0.263***	-0.321**
	(0.115)	(0.141)	(0.101)	(0.125)
log odds ratio	0.813	0.611	0.769	0.726
Treated	-0.068	-0.267**	0.026	-0.005
	(0.091)	(0.104)	(0.077)	(0.095)
*log odds ratio*p	0.934	0.765	1.027	0.995
Year×Treated	-0.036	0.346**	-0.124	0.018
	(0.132)	(0.157)	(0.116)	(0.139)
log odds ratio	0.965	1.413	0.883	1.018
N	225692	171271	284027	217521
LogL	-7254.182	-5873.86	-9731.36	-7966.429
Indirect Reform Effect[a]				
	Males		*Females*	
(2005-09)-(2007-09)	-0.095***		-0.085***	
	0.001		0.000	
log odds ratio	0.909		0.919	

First year entrants only in English universities.
All models contain the same control variables as in the base model.
Recession effect columns 2 and 4.
[a] $(\text{Year+Interaction})_{2005/09} - (\text{Year+Interaction})_{2007/09}$